TOOPS

Design of a
Division Freight Yard

Civil Engineering
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1908

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DESIGN OF A DIVISION FREIGHT YARD

BY

MICHAEL STREEVEY TOOPS

THESIS

FOR THE

DEGREE OF BACHELOR OF SCIENCE

IN

CIVIL ENGINEERING

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

PRESENTED, JUNE, 1908

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June 1, 1908

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

MICHAEL STREEVEY TOOPS

ENTITLED DESIGN OF A DIVISION FREIGHT YARD

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Bachelor of Science in Civil Engineering

James E. Smith
Instructor in Charge.

APPROVED: Ira O. Baker.

HEAD OF DEPARTMENT OF Civil Engineering

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Contents.

The Design of a Division Freight Yard for the Illinois Central Railroad at Champaign, Illinois.

Introduction.

General Principles of Design. — The most important principles to be considered in a good design of a Division Freight Yard are given below;— avoid unnecessary delays caused by engines and trains crossing over the line of other outbound or inbound engines and trains. Traffic should be kept moving continuously forward, as far as possible, that is, it is desirable that back-up movements be avoided. It is necessary to keep the Main Line clear. This feature depends in part upon the foregoing conditions. Other features of good yard design are easy curves, Switches grouped together as nearly as possible so that they can be operated easily from an Interlocking Plant, crossovers only where they are necessary, and the capacity of the various tracks adjusted to traffic conditions. The proper length of the tracks and their proper location with respect to movements from one to another reduces car movements and consequently prevents congestions and delays, and requires

the least possible switching and handling of the cars.

Definitions.—A Receiving Yard is a yard whose purpose is to receive the Inbound trains. The road engines and cabooses are cut off and the work of assorting and distributing the cars is turned over to the switch engines. Scale Tracks consist of a single track on each side of the Main Lines, located on the Continuous Tracks between the Receiving Yard and the Separating Yard. The Separating Yard is a yard next in order to the Receiving Yard, in which the traffic is separated by districts or commodities, as may be required. The Classification Yard is a yard next in order to the Separating Yard, in which the traffic is classified in accordance with requirements, and made up into trains. The Departure Yard is a yard next in order to the Classification Yard, in which the trains are placed awaiting departure. A Running Track is a track reserved for movements through a cluster. The Round House is a circular house of a number of stalls, for engines to

stand in while they are being cleaned. The Coal Station is a building consisting of a number of bins, which are filled with coal, at an elevation of 15 feet above the top of the rails of the adjacent tracks. The coal is dumped from these bins to the tenders of the engines. The Cinder Pit is a pit under the track, which receives the ashes as they are removed from the engines.

Layout or arrangement of Tracks or groups of Tracks. — The best position of the Main Line is on the outside of the yard tracks, or if the road is double tracked one Main track on each side of the yards. The reason for the above arrangement is that each yard will be readily accessible from either Main Line, and Crossovers and blockades will be avoided. The Receiving yards should be of sufficient capacity to accommodate the average number of Inbound trains, and also to provide a siding or passing track. There should be a Running track connecting the Receiving Yards with the next following yards, the Separating yards. The purpose of this track is

to avoid running over the Main Line. On this Running track should be located the Scales, so that cars can be weighed as they are being switched from the Receiving Yards to the Separating Yards. A Running track should connect the Separating Yards with the next following yards, which are the Classification Yards. Likewise a Running track should connect the Classification Yards with the Departure Yards. The object of these Running tracks is to keep the switching of cars off of the Main Line tracks. The Caboose tracks should be so located as to allow the cabooses to run by gravity to their trains, and should connect with the Departure Yards. The Caboose tracks should be continuous tracks, in order that they will be accessible from either end, thereby making it possible for the first caboose in, to be first out. The Repair tracks should consist of two groups of tracks, one for each Receiving Yard, and connecting directly with the Receiving Yard. They

should be located close to the Shops in the interval between the Receiving yards and Separating yards. With this arrangement cars needing repairs can be switched directly from the Receiving yards to the Repair tracks. The Running tracks between the different yards have already been mentioned. There should also be Running tracks leading to and from the Round House, so that engines going to or from the Round House will have as clear and nearly as direct as possible a route to and from their trains.

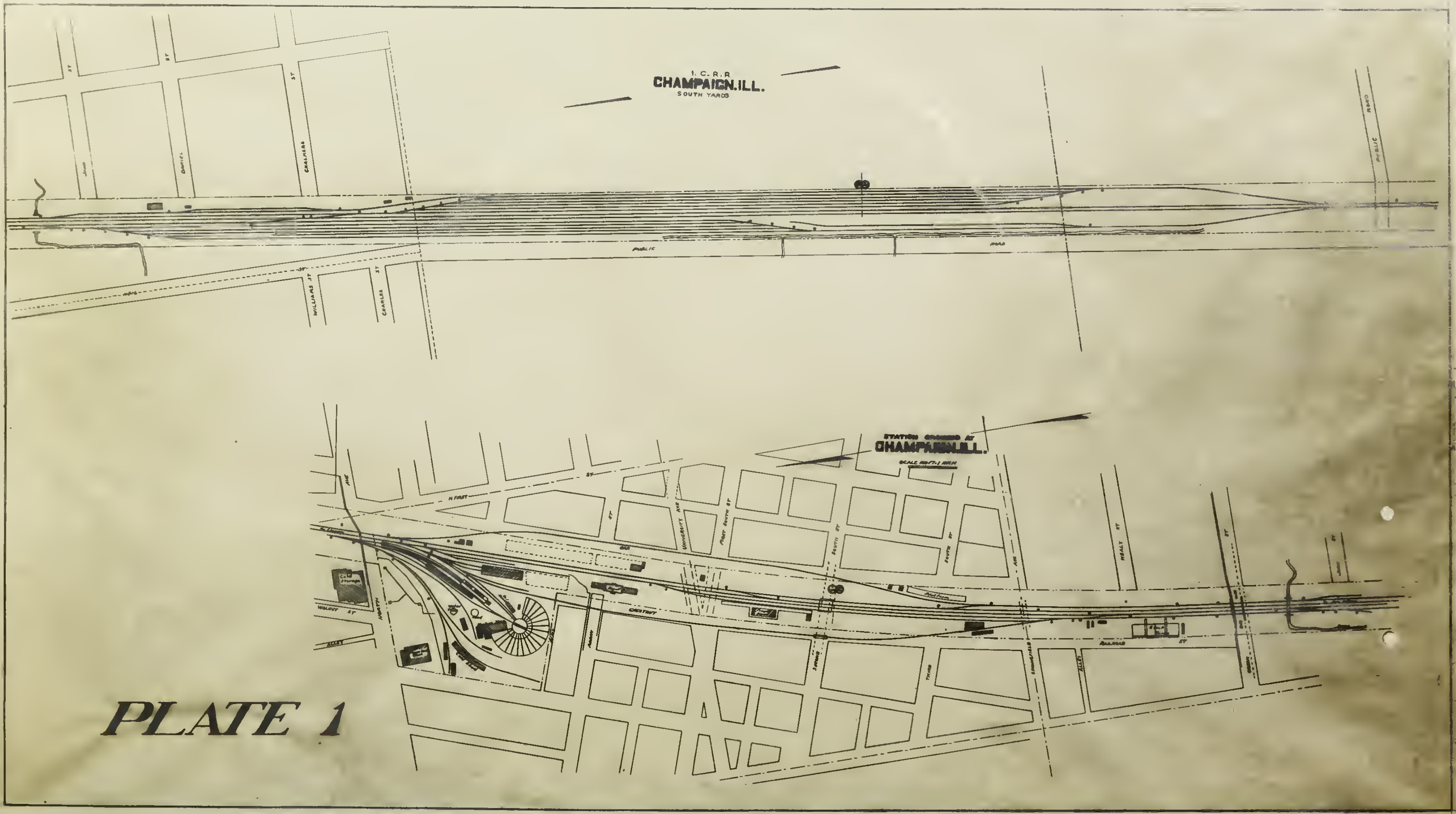
Where there is plenty of room all Ladder tracks should consist of number 9 frogs, in order to avoid sharp curves, which are very objectionable. Rigid Frogs should be used for the yard tracks, but connections with the Main Line should be made with Spring Rail Frogs. All Crossovers from one Main Line to another should be made by using either a № 10, № 11 or № 12 Spring Rail Frog.

The Round House, Shops and their ac-

cessories should be located between the North bound and South bound groups of yards, and in the center of the yards, so that the engines will have the shortest distance to run, to get to and from their respective trains. The Coal Station should be located alongside the Inbound Running track next to the Round House. The Cinder Pit should be located on the Inbound Running track just in front of the Coal Station. The Water Tank should be located close to the Round House, so as to require the least possible amount of piping, and in order that Water Cranes may be put in just a few feet in front of the Turntable, one on the Inbound Running track and one on the Outbound Running track. By the above arrangement of the Water Cranes, Coal Station, and Cinder Pit, engines can have their ashes removed, and take coal and water before they reach the Turntable. The Ice House should be located on the outside of and about

the middle of the Departure Yard. By this location cars of perishable goods can be iced without undue amount of switching. The Yard Office should be located as near the center of the yards as possible, so as to be handy for trainmen and also that an Interlocking Plant may be put in to operate the switches.

Present Location and Conditions of the Illinois Central Railroad at Champaign. — The present Illinois Central Railroad Freight yards at Champaign are not of sufficient size, nor are they best arranged to accommodate the traffic. There is no provision for separate Classification Yards, Receiving Yards and Departure Yards, there being simply one group of continuous tracks for Northbound traffic and a similar group for Southbound traffic. The Round House and Shops are about one mile from the center of the yards, and so located that engines going to and from the yards must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THIRD
SPRINGFIELD
ALLEY
RAILROAD ST
Cold Storage

PLATE 1

run over the Main Line all the way. Another objection to the present location of the Round House is that it is in the heart of the city, thus occupying expensive ground which might be better used for other purposes. The smoke is also very objectionable.

All Industrial tracks and Team tracks North of Green Street are well located as they are at present. The Round House, Shops and their accessories will be changed to the South Yards, which location will be mentioned later. The Stock yards seem to be well located and sufficiently large to provide for future increase. The Freight House and its tracks are very well arranged and will be left as they are. The lay-out of the present Yards and location of the Buildings at Champaign can be seen in the photograph of the same.

Data upon the present Traffic.—The data concerning the Traffic conditions of the Illinois Central Railroad at Champaign, and upon which the accompanying de-

sign is based follows:—

1000,- Average number of cars received every 24 hours.

100,- Average number of cars not switched during 24 hours.

1500,- Maximum number of cars handled during 24 hours.

200,- Maximum number of cars not handled during 24 hours.

85,- Maximum number of cars in one train length in the Summer time.

60-65,- Maximum number of cars in one train length in the Winter time.

100,- Number of cars of perishable goods received daily.

600,- Number of cars Northbound daily.

500,- Number of cars Southbound daily.

2-3,- Number of cars delivered to Wabash R.R. daily.

10-15,- Number of cars delivered to Big 4. R.R. daily.

25,- Number of cars delivered to Havana Line daily.

60,- Number of local cars distributed between Champaign and Mattoon daily.

25,- Number of cars distributed daily, between Mattoon and Centralia.

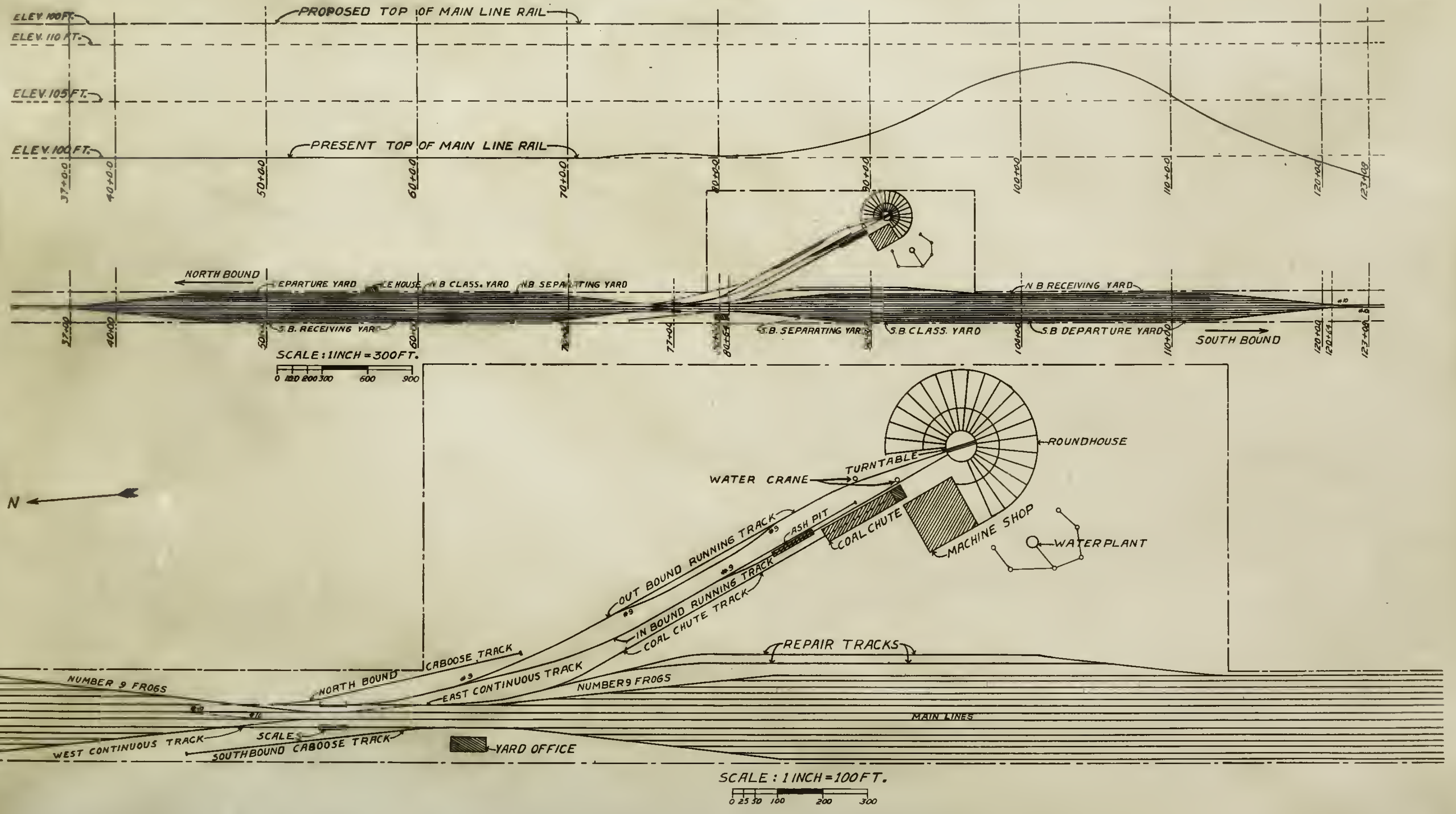
6,- Maximum number of 60-car trains

received from the South at one time.
6,- Maximum number of 65-car trains received from the North at one time.

Proposed Design. — The Traffic of the Illinois Central Railroad at Champaign is not sufficient to warrant putting in an Ideal Yard, but the purpose of this design is a Yard which will best conform to the Traffic. In the first place the extra expense of separating the Main Line tracks and placing the yards between them would not be justifiable that is, the advantages to traffic were not considered sufficiently great to justify the expense of separating the Main Line tracks. also for the same reason as stated above a separate yard will not be made for either the Separating yard, or the Classification yard, but in the best design, each of the above should consist of a separate yard for economy in separating and classifying the cars. As

PLAN AND PROFILE
OF
PROPOSED FREIGHT YARDS FOR I.C.R.R.
AT
CHAMPAIGN, ILLINOIS

MAY 1908 M.S. TOOPS



seen in the photograph, the Separating Yard, Classification Yard and Departure Yard are all one group of tracks of the same size as, and placed symmetrical with respect to, the Receiving Yard. The reason the former group are of the same size as the latter, is, that in the latter the first track next to the Main Line will be used as a passing track, while in the former extra capacity must be allowed for separating and classifying the cars. By the above arrangement the Ladders will be symmetrical, switches will be grouped, and the whole arrangement will be very favorable to an Interlocking Plant.

Receiving Yard.— The Receiving Yard will consist of six tracks, with a capacity of 375 cars (one-fourth of 1500) which is the maximum number handled in one day.

The reason for taking "$\frac{1}{4}$ of 1500" is that there will be 4 groups of tracks of the same size as already indicated. The above capacity will necessitate making the first track 4000 ft. Headblock to Headblock. The first track will be a Continuous track, spaced 17 feet center to center from the Main Line track, running through the Receiving Yard, Separating Yard, Classification Yard and Departure Yard. Each of the other five tracks of the Receiving Yard are spaced 13 feet apart, center to center, and are connected at each end by means of a ladder track.

Scale Tracks. — On the Continuous track connecting the Receiving Yard with the Separating Yard will be placed the Scales. The length of the Scales will be 45 feet. The Scales will be of the automatic design, and with this location cars can be weighed as they are being switched from the Receiving Yard to the Separating Yard.

Separating Yard and Classification Yard. —As already stated separate yards will

not be put in for the separating and classifiying of cars, but in getting the capacity of the Departure Yard about two-thirds of the capacity will be used for Separating Yards and Classification Yards. The advantage of this capacity, is, that it gives ample room for separating and classifying cars, while if no provision at all were made for these purposes, the switching would be greatly handicapped and not very economical.

Departure Yard. — The Departure Yard will be one-half the size of the Separating and Classification Yards. The total capacity of the three being 375 cars, or equal and placed symmetrical to the Receiving Yard. The size, length and spacing of the tracks will be identical to the Receiving Yard.

Caboose Tracks. — The caboose tracks will consists of spurs each 800 feet long, one for each Departure Yard, and so located that they will be closely connect-

ed to the Departure tracks. The reason they consist of spurs, is, that the way they are located it would be impracticable to connect their other ends with any track. Since they are spur tracks, there is no advantage of laying them on a descending grade toward the Departure yard, as is the case in the best design. The cabooses will be switched in and out; and further there are not enough trains in a day for this to be of any disadvantage. The capacity of the Caboose tracks will be 16 cabooses each, which is amply sufficient.

Repair Tracks — The Repair tracks are of 32 cars capacity, and consist of two parallel tracks, spaced 20 feet apart. They are connected at both ends to the Northbound Receiving Yard, thus making it possible for cars to be reached from either end. They are East of, and parallel to, the Northbound Receiving Yard. The first of these two tracks is spaced 25 feet from the outside yard track. The wide space is to allow ample room for the workmen and their tools,

in repairing cars. For Southbound traffic the cars will have to be switched across both Main Lines in order to get to the Repair tracks, which is objectionable but can not well be avoided with the proposed arrangement of the Main Lines. In the Ideal yard the Repair tracks would be located between the Northbound yards and the Southbound yards and would be easily accessible to either.

Running Tracks. — The Running tracks consist of two tracks, one for engines going to the Round House, called the Inbound Running track, and one for engines coming from the Round House, called the Outbound Running track. They are connected to the East Continuous track in the interval between the ladder Headblocks. The Running tracks are made as short as possible, but are of necessity long enough to have the ash Pit, Coal Station, Sand House and Water crane located along the Inbound Running track, as shown in the photograph. Parallel to, and 13 feet distant from, the

Outbound Running track is a track provided for six engines to stand awaiting departure. This track is connected at each end to the Outbound Running track.

Frogs, Crossovers, etc,. — Number 9 Rigid Frogs will be used on all ladder tracks, and at all other connections to tracks not on the Main Line. Where a track leads off from the Main Line a number 9 Spring Rail Frog will be used. Number 10 Spring Rail Frogs are used on the Crossovers from one Main Line to the other. All Ladders will be connected with the Main Lines, excepting the North ladder of the Southbound Departure yard and the North ladder of the Northbound Receiving yard, these ladders being connected to the Continuous tracks. The reason for making these connections to the Continuous tracks, instead of to the Main Line, is, that there is a Crossover to the Main Line at each of these places, and it is unnecessary to have ladder connections with the Main

Lines at the above mentioned places. All Crossovers have Trailing Switches. A Crossover is located between the Main Lines just to the South of the Headblocks of the South ladders of the Southbound Departure yard and the Northbound Receiving yard. Another Crossover is put in between the Main Lines with its South Headblock just to the North of the Head blocks of the South ladders of the Northbound Departure yard and the Southbound Receiving yard. Another Crossover is put in between the East Main track and the East Continuous track. These Crossovers are necessary in order that engines and cars can get from the West yards over into the East yards and vice versa.

It might be added that a standard number 9 Slip switch will be put in where the East Continuous track crosses the South ladder of the Northbound Departure Yard, and also a Slipswitch where the West Continuous track crosses the South ladder of the Southbound Receiving Yard. These Slip switches are necessary so that an

engine can get direct from the continuous track onto the ladder track. As the North ladder of the Northbound Receiving Yard, and the North ladder of the Southbound Departure yard connect directly to the East Continuous track and West continuous tracks respectively, no Slip switches will be necessary.

Machine Shops. — The Machine Shops will be a continuation of the Round House on the northwest side, and will be of ample size to keep all tools, and to make all repairs necessary to the engines.

Round House. — The Plat for the Round House, Shops, etc., is rectangular in shape, containing 27.5 acres, and is located on the East side of the yard tracks. This location is chosen because there are houses and expensive property on the West Side, while on the East side there is a cultivated field, which

can be bought for about $250 an acre. The Round House will contain 20 Stalls and will be built of brick and stone. Twenty Stalls will be sufficient to accommodate all the freight and passenger engines, that need to go in to the Round House at one time.

Coaling Station. — The Coaling Station is located along the west side of the Inbound Running track, just in front of the Round House. a track laid on an ascending grade of 4%, and supported on steel trestle work, will lead up to the Coal Bins, this track being 15 feet above the tops of the adjacent tracks where it enters and runs through the Station. The Coaling Station will have a capacity of 300 tons of coal, which is sufficient to coal 20 engines with 15 tons each. In the South end of this Coaling Station is a small Sand and Oil house, to be used to store Sand and Oil to be supplied to the

engines.

Cinder Pit. — The Cinder Pit will be located, just to the North of Coaling Station on the Inbound Running track. This Pit will be 60 feet long and constructed of concrete and steel. The Cinder track leads off of the Inbound Running track, and is on a descending grade of 2 ½ % so that the top of the average coal car will be 1 foot above the top of the rails of the adjacent tracks, when the car is alongside the Cinder Pit; the grade being level beyond the Cinder Pit. The capacity of Cinder track beyond the Cinder Pit will be 3 cars, thus making it possible to load 4 cars with cinders before any need to be pulled out.

Water Tank. — The Water Tank will be located a little to the Southwest of the Round House, and will have a capacity of 100000 gallons. The bottom of the Tank will be 85 feet above the ground

The water will be supplied from six-8 inch wells. The Tank is located near the Round House because it is at this point that the water will be used, and also, because this location will require the least possible piping to be done. Two Water Cranes will be put in for engines to take water from, one on the Inbound Running track and one on the Outbound Running track as seen in the photograph.

Ice House. — The Ice House will be located near the middle of the Northbound Departure Yard and will be on the East side of the outside yard track. The building will be 30 ft × 60 ft. This size will give ample storage for enough ice to ice all the cars of perishable goods for a period of six months. The location is made at this point because it is only the Northbound cars of perishable goods that will need to be iced, and also since this track will be little used for other

purposes.

Yard Office. — The Yard Office will be 30 ft. x 80 ft., and will be located on the West side of the West continuous track in the interval between the Headblock of the Caboose Spur for the Southbound Departure Yard and the Headblock for the ladder of the Southbound Departure Yard. An Interlocking Plant will be put in, as the Office is sufficiently large to accommodate it, and a good view of all the switches can be had from this point.

Estimate of Cost. — As it would be impossible to give the actual cost of the Design, only an approximate Estimate will be given. All of the rails in the Main Line tracks will be used, while in the yard tracks, all rails will be figured in the Estimate.

Rails	
10 tons of new rails @$28.00	$ 280.00
1668 tons of old usable rails @$26.00	43368.00
Ties.	
168 Main Line @$0.65	109.20
41700 Side Track @$0.$\overset{40}{30}$	16680.00
Spikes	
465 kegs @$3.50	1627.50
Bolts	
100 kegs @$5.50	550.00
Splice Bars.	
24 Main Line @$0.675	16.20
11120 Side Track @$0.30	3336.00
Switches Complete	
5 No 10 - 85# rail @$150.00	750.00
57 No 9 - 60# rail @$100.00	5700.00
Slip Switches	
2 No 9 - 60# rail @$250.00	500.00
Laying Track.	
0.03 miles Main Line @$500.00	15.00

15.80 miles Side Track @ $200.00	$ 3160.00
Earth Excavation 50800 yards @ $0.25	12700.00
Round House 20 Stalls @ $2000.00	40000.00
Machine Shop	5000.00
Coaling Station including Trestle work	10000.00
Cinder Pit	1000.00
Water Tank, Wells and Water Cranes	15000.00
Ice House	2000.00
Round House Plat 27.5 acres @ $250.00	6875.00
Yard Office including Interlocking Plant	15000.00
Grand Total Cost	$183666.90

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